

DOCUMENT RESUME

ED 160 108

IE 006 426

AUTHOR Thomas, James L.
 TITLE The Use of Pictorial Illustrations in Instruction: Current Findings and Implications for Further Research.
 PUB DATE 76
 NOTE 19p.; Best available copy
 EDRS PRICE MF-\$0.83 Plus Postage. HC Not Available from EDRS.
 DESCRIPTORS *Illustrations; *Pictorial Stimuli; Reading Instruction; *Research Reviews (Publications); State of the Art Reviews; Textbook Preparation; *Textbook Research; *Visual Learning; Visual Perception

ABSTRACT

Research literature indicates that haphazard selection techniques for the inclusion of pictures and illustrations in textbooks occur more frequently than do techniques employing empirical investigation. Current studies have explored a variety of factors related to the use of illustrations, such as color, time, age, achievement, and sex of the reader. Two areas receiving concentrated research are reading and science. A need is indicated for more research in the use of pictorial illustrations in facilitating specific learning objectives, in understanding the factors influencing the choice of these illustrations, and in developing research designs which will allow for the possibility of aptitude-treatment interactions. (Author/CMV)

 * Reproductions supplied by EDRS are the best that can be made *
 * from the original document. *

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

THE USE OF PICTORIAL ILLUSTRATIONS IN INSTRUCTION:
CURRENT FINDINGS AND IMPLICATIONS FOR FURTHER RESEARCH

by

James L. Thomas

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

James L. Thomas

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC) AND
USERS OF THE ERIC SYSTEM."

ED160108

IR006 426

ABSTRACT

Any individual upon examining textbooks being used for instruction is struck by the plethora of pictorial illustrations adjunct to written material. Research literature indicates that the haphazard selection technique for the inclusion of pictures in textbooks heavily outweighs the empirical investigations. Current investigations have explored a variety of factors influencing the use of illustrations, such as color, time, age, achievement, and sex of the reader. Researchers are calling for planned research designs which will allow for the possibility of aptitude treatment interaction. Two areas receiving concentrated research are reading and science. Findings to date indicate a number of other areas which need further research.

THE USE OF PICTORIAL ILLUSTRATIONS IN INSTRUCTION:
CURRENT FINDINGS AND IMPLICATIONS FOR FURTHER RESEARCH

Introduction

Historically, the use of pictures in instructional texts can be traced back to Canisius of the 16th century who "had issued a child's catechism with marginal pictures and woodcuts illustrating the lives of Christ and the saints . . ." (Saettler, 1968, p. 22). Orbus Pictus (The World in Pictures) by Comenius published in Nuremburg in 1658 was "a"visual aid" textbook written specifically for children who were studying Latin and sciences" (Saettler, p. 22). Use of pictures in textbooks in this country can be traced back to as early as 1729 when the New England Primer incorporated pictures with the text (Samuels, 1970). Even though investigations in the use of pictorial illustrations were not begun until the twentieth century, specifically with major emphasis beginning during the forties, it was not until the sixties that instructional analysts, such as Allen attempted to piece together the research trends of the past in an effort to redirect priorities for the future.

In Allen's commentary on "Audio-visual communication research" (1960), the author stated that "There is a dearth of research on the effectiveness of pictorial illustration . . . most emphasis having been placed on the preferences of children . . ." (p. 121). He ended this section on pictorial illustration with the following statement:

It appears that a great deal of study still needs to be made of the factors within pictorial illustrations that lead to increased learning and also to the kinds of content best communicated by still pictures and the techniques of using these pictures in teaching. (p. 121)

For some time an aura of confusion has existed over the use of pictorial illustrations in instruction. From this a controversy emerged regarding the role of realism in visualized instructional materials (Parkhurst, 1975). Theorists writing during the 40's and 50's maintained that visualized instructional materials could be measured in relation to their effectiveness by placement along a realism continuum. This group of theorists hypothesized that "the more realistic an instructional treatment is, the more effectively it will facilitate student learning" (Parkhurst, p. 176). Dwyer (1967) collectively called Dale's (1946/1969) cone of experience, Morris' (1946) iconicity theory, Carpenter's (1953) sign similarity theory, and Gibson's (1954) pictorial perception theory "realism theories."

In contrast to the above group of theorists, Travers, McCormick, VanMondrans and Williams (1964, 1970) and Dwyer (1967, 1972) indicated that realistic illustrations present too many irrelevant cues which interfere with the learning process. Specifically, Travers (1964) maintained that simple line drawings could be more effective as information transmitters than detailed shaded drawings or realistic

photographs and that the full realism in pictures apparently flooded the viewer with too much visual information.

Miller and Allen (1957) felt that too many irrelevant cues competed for the attention of the learner. Broadbent (1958, 1965) and Travers et al. (1964) depicted the human information storage system as a single-channel limited capacity system and the irrelevant cues had to be filtered out before pertinent information could be stored. Dwyer (1972) in his studies found that the most realistic illustrations did not make for the most effective instruction. In fact, his data showed that for specific educational objectives more simplified, colored line drawings were more effective in facilitating student achievement. The above group, labeled by Parkhurst as the "relevant cue" theorists "hypothesize that, on some educational tasks, realism in visuals accompanying instructional materials may be edited with no decrement in student learning" (p. 176).

Travers (1969) in his investigation of the advantages and disadvantages of using simplified visual presentations in instructional material felt that "the central problem--identifying the features of a picture that results in the effective communication of information--in the whole area of design for instructional purposes is one which has hardly been touched upon" (p. 21). He pointed out that a variety of functions can be served by the use of illustrations in textbooks; however, rarely are these functions identified. Travers also explained that one of the most systematic accounts of the relationship of illustrations and printed

material has been carried out by Smith (1960). Smith in his findings hypothesized that illustrative material in textbooks are usually included for two main reasons: as incentive or motivation to catch the attention of the viewer by enhancing the printed material, or as information-giving to provide information not readily codified in words, partly codified in words, to provide new experiences that the learner has not previously encountered or to link verbal generalizations in the text with the world or phenomenal experience.

Related Studies into Factors Influencing
the Use of Illustrations

Color. Although reviews by Reid and MacLennan (1967), Kanner (1968), and Bretz (1970) corroborate the evidence that people generally prefer color, the effective use of color for instructional purposes has not adequately been investigated. Travers (1969) speculated that the lifelike appearance when using color over black and white facilitated the child's ability to perceive dynamic features of the picture. Dwyer (1972) felt that color visuals perhaps were more attractive and thus students attended more diligently. Holliday (1973) maintained that due to the lack of adequate investigation, "no conclusive statement can be made about the effect of color on the learner" (p. 211). However, Dwyer's (1976) most recent findings appeared to give direction to the use of color: "In terms of instructional effectiveness . . . the simple line drawing presentation

(color) was found to be the treatment most effective in facilitating student achievement . . ." (p. 60).

Time. Broadbent (1958, 1965) and Travers et al. (1964) hypothesized that the human information processing system had a single-channel limited-capacity capability and that for information to be stored, irrelevant cues must be filtered out. Dwyer (1970) and Fleming and Sherkhian (1972) indicated that abstract, low-information pictures are more effective in fixed-pace presentations or for a short duration, whereas realistic, high-information pictures which the learner self-paces yielded more effective or superior learning. However, Wicker (1970) investigating paired-associate learning and Paivio, Rogers, and Smythe (1968) in free recall discovered that detailed pictures did not significantly improve learning when compared with line drawings even under the self-pacing condition. Holliday (1973) has questioned these findings stating that "This is still another area of visualized instruction that needs to be investigated further before these kinds of experimental results can be directly used to instructional designers" (p. 205). Dwyer (1976) in his findings indicated that students on a fixed-pace presentation are at a disadvantage when attempting to process the information contained in realistic pictures.

Age. Travers (1969) hypothesized that "pictures are of doubtful value for communicating anything other than the simplest pieces of information to young children in the

lower elementary grades" (pp. 55-56). Travers and Alvarado (1970) maintained that "Research has established that, as the child grows older, his capacity of handling complex stimuli increases" (p. 54). Lynch and Rohwer (1971) found that response learning by sixth graders was facilitated by pictorial elaboration. Levie (1973) stated that "Many researchers (Dilly and Paivio, 1968; Brown, 1969; Macworth and Bruner, 1970; Asso and Wyke, 1970) have found that the ability to learn from pictures increases with age and education" (p. 43). Hanes (1973) reported in his review of the research that there "appears to be a consistent preference for complexity and variability across a wide age range" (p. 17). Specifically, he cited a study by Hutt and McGraw (1969) that demonstrated that "five year olds view simple figures longer, eleven year olds viewed complex figures longer, but eight year olds showed no difference in viewing times" (pp. 16-17).

Achievement. Few researchers have systematically investigated the relationship between differing achievement levels and effectiveness of pictorial illustrations as used in instruction. Gropper (1966) found that high I.Q. students benefitted more from verbal instruction than did low I.Q. students and that low I.Q. profited more from pictorial instruction than did the high I.Q. students. Holliday (1973) maintained that "It has been shown that differential visual aptitudes exist among individuals"; yet he also called for additional verification of this position (p. 201). Allen (1975) in his summary of research findings

maintained that "There is no apparent support for the supposition that individuals of higher mental ability may learn more from verbal treatments and those of lower ability from pictorial treatments" (pp. 142-143). Allen also in his tentative generalizations called for systematic research regarding intellectual abilities and instructional media design. He felt from this initial investigation that individuals of both low and middle mental ability appear to be deterred in their learning by instructional procedures that

Contain amounts of information, both verbal and visual, that exceed the information processing capabilities of the learner. Contain content that develops at a rate of speed too rapid for adequate mental processing of the information transmitted.

(pp. 158-160)

Allen pointed out that very little research has ever been conducted with middle ability students. In contrast to the above, Allen hypothesized that the high mental ability group could benefit from an instructional procedure which was perceptually rich and that employed a rapid pace.

Sex of the reader. Dwyer (1971) in a study limited to grades nine through twelve has shown that "there are no special requirements based on sex for using specific types of visuals to provide maximum achievement of specified educational objectives" (p. 28). Holliday (1973) concluded

that Dwyer's study regarding sex appeared within the limitations to be accurate.

Aptitude Treatment Interaction and Pictorial Illustrations

Levie (1973) hypothesized that "the general lack of evidence relating pictorial stimulus variables to learning effectiveness may be due to the predominance of research designs that measure only intended, not possible outcomes:" (p. 42). A number of researchers in the past have come across an interaction effect without planning for it (Allen, 1975). Looking for possible interactions between various treatments and measures of general ability of achievement must be taken into account before empirical investigation begins (Holliday, 1973, 1975, 1976) and Cronback and Snow (1976). Parkhurst (1975) recommended the use of aptitude treatment interaction (ATI) as a means of clarifying the discrepancy of the degree of realism in pictures and their instructional effectiveness with different levels of achievement with students. Shulman and Tamir (1973) specifically recommended the use of ATI with research in the science education area.

Research into the Use of Pictorial Illustrations in Reading

Reading is an area which has received specific investigation into the use of pictures adjunct to the written text.

Weintraub (1960), Samuels (1967, 1970), and Dwyer (1972) indicated that pictures when used as adjuncts to printed text do not facilitate learning. Specifically, Weintraub found that reading comprehension was greatest when pictures were not used with the text. Samuels (1970) confirmed these findings and concluded that "There was almost unanimous agreement that pictures, when used as adjuncts to the printed text, do not facilitate comprehension" (p. 405). Samuels also explained that "pictures had no effect on the better reader, but among the poor readers, the presence of pictures interfered with learning . . ." (p. 399). Vernon (1953) and Burdick (1960) investigating science content in their treatments supported this position. However, Pederson (1970) in his testing of children reading one-two years below their placement pointed out that pictures neither facilitated nor hindered comprehension skills. Koenke and Otto (1969) found that with sixth grade students pictures facilitated the retention of factual information but not the comprehension of content. Weisburg (1970) found that a graph or map could serve as a more effective means of learning earth science concepts than verbal expository. Holliday (1975) could not support the thesis "pictures don't help" nor the antithesis. However, he pointed out that the results of his study "demonstrate that a certain kind of picture--simplified line drawings--can significantly facilitate a form of verbal comprehension" (p. 79).

Research into the Use of Pictorial Illustrations
in Science Education

Although numerous researchers in education have investigated the use of pictorial illustrations in instruction, at present, science education appears to be an area receiving a great deal of attention. Vernon (1953), Burdick (1960), Weisburg (1970), and Miller (1971) have investigated differing aspects of visuals as related to science. However, two names--Dwyer and Holliday--are consistently referenced throughout the literature. Dwyer has conducted over the past nine years the most comprehensive examination of pictures as a medium of instruction. Holliday has given credence to Dwyer's findings and has attempted through his investigations to formulate a basis for future research in the area.

Dwyer has reported thirty-three separate studies based upon similar instructional treatments, experimental design, statistical analysis, and evaluative criterion. Eight types of visuals were usually employed showing cross-sectional pictures of the human heart: simple line drawings (black & white / color), detailed shaded drawings (black & white / color), photographs of a heart model (black & white / color), and photographs of an actual heart (black & white / color). In addition to the eight visuals, Dwyer included a verbal description accompanying the pictures. His "control" groups viewed only the written labels on the visuals with the verbal descriptions. Four dependent variables and

Five major objectives were examined:

- (1) Drawing test: this test evaluated student learning of the positions of the parts of the heart;
- (2) Identification test: this test was designed to measure transfer of learning, i.e., the ability to identify numbered parts on a diagram of the heart from information received in the instruction;
- (3) Terminology test: to measure knowledge of specific concepts and symbols;
- (4) Comprehension test: this test required that the student have a thorough understanding of the heart; and
- (5) Total Criterial test (composite of #1-#4): to measure total understanding of the concepts presented. (Dwyer, 1972, pp. 18-19)

Holliday (1973) in his evaluation of Dwyer's research stated that "His experimental and statistical techniques were appropriate for the research questions under investigation" (p. 203). However, although Holliday felt that Dwyer has made a vital contribution to the area of visualized instruction, he warned that "before some of Dwyer's results can be utilized directly in the design of science instruction, additional related studies must be performed to fill in the spaces in the theory emerging and its generalizability to various levels of learning in science" (p. 205).

Dwyer (1972, 1976) has not only added to the already existing support for the "relevant cue" theory but has also shown the need for additional analysis of the effectiveness

of pictorial illustrations adjunct to verbal material as it possibly influences comprehension. Recognizing the need for additional investigation, Holliday (1975) in analyzing the effects of verbal and adjunct pictorial-verbal information in science education used two instructional stimulus units: (1) "textbook-like" pictures--simplified line drawings--with verbal text and (2) verbal text only. In running a one-way analysis of variance, he found that there was a significant difference in favor of the students who had the adjunct pictorial-verbal material. In his results and discussion of the investigation, he concluded that

The results of this experiment do not support a "pictures don't help" hypothesis as ascribed by many investigators on the topic nor does it confirm the antithesis of this hypothesis. This study does demonstrate that a certain kind of picture or illustration can significantly facilitate a form of verbal comprehension. This information had not been clearly demonstrated in other experiments.

(p. 79)

Both Dwyer and Holliday in their research concluded that more empirical investigation is needed in the field. Before an adequate theoretical base of how children on all levels of education learn from differing the inclusion of pictures with written text can be formulated and defended, more systematic research needs to be conducted in specific areas.

Implications for Further Research

In reviewing the current findings more research was called for into the use of pictorial illustrations in facilitating specific learning objectives by students and into certain factors influencing the choice of these illustrations. Most research by the two leaders in this specific area--Dwyer and Holliday--has been conducted on high school and college science students. It would appear to be necessary to investigate all levels of education using a variety of subject areas. Of particular interest should be the need for the following inquiries:

- (1) Does varying the pictorial-written content of a particular subject influence the comprehension of different achievement levels on different educational levels?
- (2) Does the degree of correlation between the written text and the pictures influence the learning of the material by the student? Virtually no research exists in this area.
- (3) Does varying the inclusion of pictures influence different types of specific learning objectives, such as factual information, concept formation, perceptual-motor skills, appreciation, etcetera?

REFERENCES

- Allen, W. H. Audio-Visual Communication. In C. W. Harris (Ed.), Encyclopedia of Educational Research (3rd ed.). New York: Macmillan Company, 1960.
- Allen, W. H. Intellectual abilities and instructional media design. AV Communication Review, Summer 1975, 23, 139-170.
- Bretz, R. Color television in instruction. Santa Monica, California: Rand Corp., 1970.
- Broadbent, D. E. Information processing in the nervous system. Science, 1965, 3965, 457-462.
- Broadbent, D. E. Perception and Communication. New York: Pergamon, 1958.
- Burdick, J. G. A study of cross-section drawings used as technical illustrations in high school science textbooks (Doctoral dissertation, Syracuse University, 1959). Dissertation Abstracts, 1960, 20, 2707-2708.
- Cronbach, L. J., & Snow, R. E. Aptitudes and instructional methods: a handbook. Halsted Press, 1976.
- Dale, E. Audio-visual methods in teaching. New York: Dryden Press, 1969. (Originally published, 1946.)
- Dwyer, F. M. Adapting visual illustrations for effective learning. Harvard Educational Review, 1967, 37, 250-263.
- Dwyer, F. M. The effect of IQ level on the instructional effectiveness of black-and-white and color illustrations. AV Communication Review, Spring 1976, 24, 49-62.
- Dwyer, F. M. Exploratory studies in the effectiveness of visual illustrations. AV Communication Review, 1970, 18, 235-249.
- Dwyer, F. M. A guide for improving visualized instruction. Pennsylvania: Learning Services, 1972.
- Dwyer, F. M. Visual learning: an analysis by sex and grade level. California Journal of Education Research, 1971, 22, 170-176.
- Fleming, M. L., & Sherkhian, M. Influences of pictorial attributes on recognition memory. AV Communication Review, 1972, 20, 423-441.

- Gibson, J. J. A theory of pictorial perception. AV Communication Review, 1954, 1, 3-23.
- Gropper, G. L. Learning from visuals: some behavioral considerations. AV Communication Review, 1966, 14, 33-39.
- Holliday, W. G. Conceptualizing and evaluating learner aptitudes related to instructional stimuli in science education. Journal of Research in Science Teaching, 1976, 13, 101-109.
- Holliday, W. G. Critical analysis of pictorial research related to science education. Science Education, 1973, 5, 201-214.
- Holliday, W. G. The effects of verbal and adjunct pictorial verbal information in science instruction. Journal of research in science teaching, January 1975, 12, 77-83.
- Koenke, K., & Otto, W. Contribution of pictures to children's comprehension of the main idea in reading. Psychology in the Schools, 1969, 6, 298-302.
- Levie, W. H. Pictorial research: an overview. Viewpoints, March 1973, 49, 37-45.
- Miller, L. K. Developmental differences in the field of view during tachistoscopic presentation. Child Development, 1971, 42, 1543-1551.
- Miller, N. E., & Allen, W. A. Graphic communication and the crisis in education. AV Communication Review, 1957, 5, 1-120.
- Morris, C. W. Signs, language and behavior. New York: Prentice Hall, 1946.
- Paivio, A., Rogers, T. B., & Smythe, P.C. Why are pictures easier to recall than words? Psychonomic Science, 1968, 2, 137-138.
- Parkhurst, P. E. Generating meaningful hypothesis with aptitude-treatment interactions. AV Communication Review, Summer 1975, 23, 171-183.
- Pederson, D. L. The effect of pictures on primary grade children's comprehension of basal readers (Doctoral dissertation, University of Minnesota, 1970). Dissertation Abstracts International, 1971, 32(01-A), 311. (University Microfilms No. 18875).

- Reid, J. C., & MacLennan, D. W. Research in instructional television and film. Washington, D.C.: Bureau of Research, U.S. Office of Education, HEW, 1967.
- Saettler, P. A history of instructional technology. New York: McGraw-Hill Book Co., 1968.
- Samuels, S. J. Attentional process in reading: the effect of pictures on the acquisition of reading responses. Journal of Educational Psychology, 1967, 58, 337-342.
- Samuels, S. J. Effects of pictures on learning to read. Review of Educational Research, June 1970, 40, 397-407.
- Shulman, L. S., & Tamir, P. A. Research on teaching in the natural sciences. In T. M. W. Travers (Ed.), Second handbook of research on teaching. Chicago: Rand McNally and Co., 1973.
- Smith, K. U. The scientific principles of textbook design. AV Communication Review, 1960, 8, 27-49.
- Travers, R. M. W. A study of the advantages and disadvantages of using simplified visual presentations in instructional materials, final report (Grant No. OEG-1-71070144-5235). U.S. Office of Education, 1969. (ERIC Document Reproduction Service No. ED 031 951.)
- Travers, R. M. W. The transmission of information to human perceivers. AV Communication Review, 1964, 12, 373-385.
- Travers, R. M. W., McCormick, M. C., Van Mondfrans, A. P., & Williams, F. E. Research and theory related to audio-visual information transmission. Salt Lake City: University of Utah, Bureau of Educational Research, 1964.
- Vernon, M. D. The value of pictorial illustration. British Journal of Educational Psychology, 1953, 23, 171-179.
- Weintraub, S. The effect of pictures on the comprehension of a second grade basal reader (Doctoral dissertation, University of Illinois, 1960). Dissertation Abstracts, 1960, 21(06), 1428.
- Weisburg, J. S. The use of visual advance organizers for learning earth science concepts. Journal of Research in Science Teaching, 1970, 2, 161-165.
- Wicker, F. W. On the locus of picture-word differences in paired-associate learning. Journal of verbal learning and verbal behavior, 1970, 9, 52-57.